

SCOPING DOCUMENT FOR THE INTER-AGENCY TECHNICAL TASK FORCE ON E. COLI FOR THE INDIANA SHORELINE ON LAKE MICHIGAN

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INTRODUCTION

Each summer thousands of people visit Indiana Dunes National Lakeshore (INDU), Indiana Dunes State Park, and other public and private sites with access to Indiana's Lake Michigan shoreline. In past years, officials occasionally have closed beaches because of high bacteria counts. Agencies monitor coliform because swimmers exposed to elevated levels of bacteria and coincidental pathogens risk ear, skin and intestinal infections. High coliform concentrations often represent excessive introduction of waste which has the potential to cause lower dissolved oxygen levels, excess nutrients, and contaminant introduction in ambient water, thus impairing aquatic habitat. Although no study documents the effect that beach closings have on the regional economy, repeated beach closings may discourage visitors and affect the local tourism industry negatively.

Bacteriological quality for recreational uses is established by rule and set forth in the Indiana Administrative Code, Title 327, Article 2, Section 1, Subsection 6 (327 IAC 2-1-6). The criteria Indiana uses to evaluate full body contact for recreational uses follows:

Escherichia coli (E. coli) concentrations shall not exceed 125 cells per 100 ml water as a geometric mean based on not less than five samples equally spaced over a thirty day period nor exceed 235 cells per 100 ml water in any one sample. Preliminary studies associate high E. coli concentrations with heavy rainfall, and wind direction, but the data are not sufficient to confirm this association. Scientists do not understand how extensively tributaries transport E. coli to Lake Michigan. Because of this uncertainty, this report examines various sources of high E. coli concentrations throughout the Lake Michigan basin.

The Inter-Agency Technical Task Force on E. coli (Task Force), consisting of technical experts from local, state, and federal agencies, seeks a comprehensive approach that addresses beach closings. Participation in the Task Force is voluntary. This scoping document intends to establish the parameters and standards for planning and research that the Task Force addresses. From a geographic perspective, the scoping document covers the Indiana portion of the Lake Michigan basin. Figure 1 shows the Lake Michigan basin and its tributaries. As data from projects is collected and analyzed, the Task Force will develop an implementation strategy that can address causes and solutions to periodic coliform bacterial contamination of Indiana's beaches on Lake Michigan. The members of the Task Force agree that the strategy will include consistent methods of data collection, the development of a real-time forecasting system, identification of the sources and fate of the bacteria, and a systematic program of remediation.

BEACH CLOSINGS THROUGHOUT LAKE MICHIGAN

Parameters which generally determine beach closings include fecal coliform or E. coli. The national standard for E. coli as developed for freshwater beaches in EPA guidelines is 126 E. coli per 100 ml based on a geometric mean over 30 days. State standards may be more stringent than the federal standards but may not be less stringent (Arnold Leder, US EPA, October 21, 1996). Illinois, Indiana, Wisconsin and Michigan each have different standards for fecal coliform or E. coli (Table 1).

Table 1
Lake Michigan States' Coliform Criteria and Reported Beach Closings

STATE	REQUIRES BEACH MONITORING	AGENCY	STATE CRITERIA	CLOSED AREAS	CAUSE OF PROBLEM
ILLINOIS		city or county health departments	< 200 fecal coliform/100 ml for a five-day geometric mean taken over 30 days >100 fecal coliform/100 ml in any two samples is enough to	Waukegan area beaches Chicago beaches	Between 1989 and 1992 sanitary waste from sewer overflows or bypasses and partially treated wet-weather overflows closed Waukegan

			require investigation and corrective action >500 fecal coliform /100 ml or 5000 total coliform/100 ml in two consecutive samples, close beach		area beaches. No 1995 beach closings. In 1994, the City of Chicago reported four days where different beaches closed. Chicago Parks Department attributes few beach closings to the Metropolitan Water Reclamation District's Deep Tunnel Project (Peccoraro, 1996). This project upgraded the city's sewer infrastructure tremendously.
INDIANA		County health departments / National Park Service	< 235 E. coli/100 ml <125 E. coli/100 ml over a 30-day geometric mean using at least 5 samples	No beaches consistently close	Various
MICHIGAN		county health departments	<300 E. coli/100 ml < 130 E. coli/100 ml over a 30-day	Hibbert Drain outfall into Lake Michigan and Sunny	During 1992 and 1993, improper sewage treatment led to beach

			geometric mean	Shores (east of Manistique)	closings at both locations.
WISCONSIN	State legislature repealed this requirement	some counties do monitor	<200 E. coli/100 ml H2O > 1,000 E. coli/100 ml H2O - harmful to fish 0 E. coli/100 ml H2O - drinking	Bay Beach in southern Green Bay and Milwaukee	Between 1990 and 1991 the Milwaukee County Health Department closed South Shore beach 28 times. These closings lasted 48 - 96 hours after CSO events.

Except in Wisconsin, Lake Michigan beaches are periodically monitored. In Indiana, monitoring is traditionally performed by county health departments. The health departments in Lake, Porter, and LaPorte Counties have all performed monitoring of public beaches along Lake Michigan. Pursuant to 410 IAC 6-7-3(G)(3), beaches in camps must be tested for bacteria before the start of the swimming season and weekly throughout the season. The Indiana Dunes National Lakeshore also monitors its bathing beaches on a weekly basis. Table 2 has a list of the sites where INDU staff sample for E. coli. Given the differences among states, comparing problems with beach closings across Lake Michigan and on a national scale is not straightforward. When bacterial counts are available, data is not comparable because each state in the Lake Michigan basin has different monitoring protocols.

Table 2
Indiana Dunes National Lakeshore
Sites for E. coli Monitoring

Kemil Road
Marquette Park
Lakeview
West Beach
Central Avenue
Ogden Dunes
Mount Baldy
Porter Beach

Dune Acres
Dunes Creek @ Lake Michigan
Dunes State Park W
Derby Ditch @ Lake Michigan
Dunes State Park E

Of the locations in Table 2, Dunes Creek and Derby Ditch both are ditches in the Great Marsh, within INDU property. These sites and Kintzele Ditch, which is not monitored, empty to Lake Michigan and consistently have high E. coli concentrations. (Whitman R. et al., 1995) Scientists do not yet know whether the relative contributions of these ditches are the sources of high E. coli concentrations for Indiana's Lake Michigan shoreline. Excessive E. coli contaminations in Salt Creek, Little Calumet River, and Burns Ditch have also been recorded. (Whitman, 1996). Table 3 shows how often E. coli counts have exceeded Indiana's standard of 235 cells / 100 ml water.

Table 3

Number of Documented E. coli Counts that Exceed Indiana Criteria for a Single Sample Beaches Where Indiana Dunes National Lakeshore Samples

Year	# of Documented High E. coli Counts
1990	22
1991	14
1992	22
1993	26
1994	21
1995	12
1996	6

AREA CHARACTERIZATION

Indiana's drainage pattern may partly explain the occasional high E. coli concentrations in nearshore areas. The 45-mile shoreline accommodates a diversity of uses, including heavy industry, residential communities, recreation sites, and natural areas. Throughout the lakeshore, there are hundreds of acres including wetland, woodland, and dune and swale ecosystems. The western part of the lakeshore is a large industrial and commercial complex. The eastern shoreline is less industrialized; it has residential land use, INDU, and some industrial development. Michigan City in LaPorte County accounts for urban land use on the eastern shoreline. In 1990 approximately 86 percent of the watershed's population of 607,424 resided in urban areas. The total population of the watershed has been declining since the 1970's and is expected to decline during the next two decades. Overall, the population is shifting to suburban areas on the southern watershed boundary, away from the high urbanized northern areas (NIRPC, 1995).

AN ALTERED HYDROLOGY - DITCHED WETLANDS

An extensive system of dunal ponds and broad wetlands, arranged in rows roughly parallel to the existing shoreline, comprised the presettlement Indiana Lake Michigan basin. The Calumet River system was a primary tributary of Lake Michigan that turned eastward into a small inlet near the southern Lake Michigan. A sluggish coastal stream, the Calumet system included expansive riparian wetlands adjacent to old dune ridges. Trail Creek and Dunes Creek were minor natural drainage areas. The wetlands worked like a sponge -- slowing, absorbing, and filtering large volumes of surface runoff. In filtering runoff, wetlands, dunal ponds, and coastal rivers biologically could treat natural and man-made waste before entering Lake Michigan (Whitman, 1995).

The present ditched and fragmented landscape is a dramatic change from pre-settlement conditions. In the early 1900's, settlers created an elaborate network of ditches to drain the region and rendered the development of waterways, railroads, highways, communities, heavy industry, and farmland.

Urbanization and its impermeable surfaces direct runoff to ditches, storm drains, drainage tiles, and channelized river systems (Whitman, Fagre, Pavolvic, and Cole, 1994).

IDENTIFYING SOURCES OF E. coli

The altered northwest Indiana hydrology allows surface runoff to disperse E. coli and sediments easily into Lake Michigan. E. coli comes from various sources, some poorly understood, within the basin. It is likely that the relative contribution of each source is different in the various watersheds within Indiana's portion of the Lake Michigan basin. This makes it difficult to apply uniform remediation measures throughout the affected area (Olyphant, 1996). The paragraphs below summarize general knowledge about various sources of E. coli bacteria.

Combined Sewer Overflows (CSO)

A combined sewer system is designed to carry both sanitary sewage and stormwater runoff. A combined sewer overflow (CSO) event occurs when stormwater overloads a combined sewer system. The Indiana Department of Environmental Management (IDEM) deems any dry weather CSO discharges illegal. Illegal connections to storm sewers may cause dry weather CSO discharges. In April 1996, IDEM issued a Final Combined Sewer Overflow Strategy. This Strategy follows U.S. EPA guidelines and each city within the Lake Michigan basin must follow the State's CSO Strategy by January 1, 1997. Chesterton, East Chicago, Gary, Hammond, Michigan City, and Valparaiso are cities within the Lake Michigan basin that have CSOs. Table 4 lists the number of CSOs that these cities have identified and the tributary to which the publicly owned treatment work (POTW) discharges. None of the cities' POTWs discharge to Lake Michigan, however, the receiving waters are tributaries of Lake Michigan. When cities develop their Long-Term Control Plans, another State CSO Strategy requirement, they will estimate bacterial loads entering the receiving waters. This information, in addition to hydrologic and biological studies, can help agencies understand CSOs' relative contribution to E. coli loadings in nearshore Lake Michigan.

Table 4
POTWs in Lake Michigan Basin
March 1995

City	Number of Reported CSO Outfalls	Receiving Waters
Chesterton	1	Little Calumet River
East Chicago	3	Grand Calumet River
Gary	12	Grand Calumet River
Hammond	14	Grand Calumet River
Michigan City	3	Trail Creek
Valparaiso	3	Salt Creek

Failed Septic Systems

The Indiana State Department of Health administers rules for the installation of septic systems. Each county health department registers permits for the installation of septic systems. However, no county health department or sanitary district has comprehensive information on the locations of septic systems. The following communities have residential areas with septic systems: Gary, Ogden Dunes, Dune Acres, Beverly Shores, portions of Michigan City, Town of Pines, Town of Trail Creek and Pottawatomie Park. Inspectors from the State Health Department can inspect problematic residential septic systems with staff from the county health departments. However, staff mostly conduct these inspections as they receive complaints. The determination of how many septic systems are in operation and their location within the basin would be supported.

The Indiana Geological Survey and the Indiana State Department of Health evaluated the performance of 70 drywells in Beverly Shores. Study results show that leachate containing bacteria has contaminated shallow ground water in the immediate vicinity of some dry wells. The regional water table gradient from this drywell area flows northward to Lake Michigan. However, mounding below septic system drywells causes local variations in the size and direction of the gradient. The Survey concluded that when the sand is not saturated, contamination of the Indiana Dunes water-table aquifer of the Indiana Dunes is minimal (Olyphant and Harper, 1995). Whitman and Gerovac (1996b) demonstrated that upgradient sources of *E. coli* in open beach sands were unlikely.

Indiana Dunes National Lakeshore has numerous buildings throughout its properties on Lake Michigan. The Lakeshore has 12 facilities operating with a septic system.

Point Source Discharges

IDEM operates the National Pollutant Discharge Elimination System (NPDES) permitting process for the State of Indiana. With NPDES permits, facilities may discharge treated flows from point sources to receiving waters. Facility violations for bacteria may exacerbate the beach closing problems in nearshore Lake Michigan. Total suspended solids have been correlated with high levels of bacteria. However, scientists do not know whether a facility's violations for non-residue parameters also exacerbate beach closures. For conventional pollutants, IDEM designates a facility in significant non-compliance when the effluent limit exceeds the permit limit by 40 percent or more. For

toxic pollutants, IDEM designates a facility in significant non-compliance when the effluent limit exceeds the permit limit by 20 percent or more. No facilities that discharge directly to Lake Michigan are in significant non-compliance for total suspended solids or bacteria. However, several of the facilities that discharge to tributaries in the Lake Michigan basin violate parameters for total suspended solids.

Marine Sources

Marine sources of bacterial contamination present a number of complexities, both in terms of legal controls and in terms of the contribution of marine sources to water pollution and beach closings. Four principal types of water are found on board vessels. (1) "Waste water" may be taken onboard for sanitary systems or ballast water. (2) "Potable water" may be used for drinking, showers, cooking, and galley washing. The latter uses may result in potable water becoming what is sometimes called "gray water." (3) "Engine room water" includes cooling water and boiler make-up water. (4) "Incidental water" includes rainwater and spray from waves on the deck, and it also includes bilge water.

The discharge of untreated sewage from any vessel in Lake Michigan or a navigable tributary is generally prohibited both by federal and state law. Acting under 33 USC 1322(b), the U.S. Coast Guard has adopted regulations to "prevent the discharge of untreated or inadequately treated sewage" from vessels, except vessels not equipped with toilet facilities. As provided by Indiana law at IC 14-15-2-7, sewage collected in a vessel's holding tank may not be disposed except through an approved disposal facility. Enforcement of these prohibitions is not, however, easily accomplished. The DNR's Division of Law Enforcement regularly inspects toilet facilities on a charter boat but typically does not inspect a recreational vessel unless a complaint is received.

IDEM is funding the construction of new, and the rehabilitation of existing, pumpout stations through the Clean Vessel Pumpout Program. By rule adopted at 310 IAC 21-4-3, the Indiana Natural Resources Commission effectively requires marinas, located on Lake Michigan or its navigable tributaries and servicing more than five boats, to provide pumpout stations.

Federal regulations authorize the disposal of treated sewage on the Great Lakes from a qualified marine sanitation device (MSD), although even larger recreational vessels operating on Lake Michigan typically are fitted to hold sewage for disposal into a pumpout station. A state may completely prohibit the discharge from all vessels of treated sewage upon a proper showing to the EPA. For Lake Michigan, Wisconsin and Michigan have secured discharge prohibitions through this process. Indiana and Illinois have not.

The U.S. Coast Guard has adopted regulations to control the release of ballast water from vessels entering the Great Lakes, but the regulations do not govern activities within the Great Lakes. The Great Lakes Carriers' Association has designed a voluntary effort directed to the discharge of ballast water within the Great Lakes.

The discharge of gray water is not generally prohibited, and gray water may contain significant bacterial contamination. Gray water is exempted from NPDES permitting requirements.

Incidental water includes bilge water, rainwater, and lake spray. Bilge water accumulates in a vessel as a result of sweat or minor weeping of rivets and seams. The customary practice on a commercial vessel is to "sound the bilges" at least once a day. Rainwater and spray either flows from the decks or may be pumped out in accordance with the MARPOL convention.

Non-point Source Pollution

Nonpoint source pollution is water pollution originating from diffuse, nondiscrete sources that are not regulated as point sources by the Clean Water Act's National Pollutant Discharge Elimination System Program. Nonpoint source water pollution generally results from land runoff, percolation, atmospheric deposition, hydrologic modification, or precipitation. (Definition adopted by the Indiana Department of Environmental Management Nonpoint Source Task Force July 1996.)

As defined by Indiana statute IC 13-11-2-260, "water pollution" means: (1) actual or threatened alteration of the physical, thermal, chemical, biological, bacteriological, or radioactive properties of any waters; or (2) the discharge or threatened discharge of any contaminant into waters that does or can create nuisance or render the waters harmful, detrimental, or injurious to:

- (A) public health, safety, or welfare;
- (B) domestic, commercial, industrial, agricultural, recreational, or other legitimate uses;
- or
- (C) livestock, wild animals, birds, fish, or aquatic life.

Nonpoint source pollution, through animal waste, can contribute to high bacterial concentrations. Presently, scientists have not determined whether human or animal waste is a greater source of *E. coli* concentrations. However, researchers, like Everett Ting at Purdue University, are studying methods to differentiate animal and human sources of *E. coli*. Pet waste on beaches may contribute to higher bacterial concentrations in nearshore waters. In the Great Marsh, scientists suspect that animal waste is a major source of bacteria to Derby Ditch, Dunes Creek and Kintzele Ditch. (Whitman et al., 1995).

Agricultural nonpoint source pollution, through livestock farming, can cause high *E. coli* concentrations. Where livestock farming occurs on a large scale, Indiana requires that farmers develop a confined feeding disposal plan. These plans are not enforceable, but do encourage measures that prevent livestock wastes from contaminating watersheds. Several smaller livestock farms that do not have a confined feeding requirement can raise *E. coli* concentrations collectively. Although previous sections indicate that much of the Lake Michigan basin is industrial land use, some areas support livestock.

Scientists suspect that nonpoint source pollution can raise bacterial counts in ambient water due to increased levels of suspended solids. High levels of bacteria coincide with high amounts of total suspended solids. As streams transport suspended solids through a watershed, the sediments can adsorb bacteria and eventually transport bacteria to Lake Michigan. Agriculture practices that cause erosion contribute a major source of total suspended solids in runoff. Within the Lake Michigan basin, urban runoff, too, contributes significant loadings of total suspended solids to various tributaries.

AGENCY EFFORTS

Each agency on the Task Force individually undertakes efforts that can help reduce bacterial loadings to the nearshore waters of Lake Michigan. Collectively, agencies on the Task Force pursue objectives that help curtail beach closings on Lake Michigan. These objectives are: integrate agency efforts, establish uniform testing standards and techniques, increase the effectiveness and efficacy of the present monitoring programs, reduce duplication to support cost efficiency, form partnerships to maximize funding opportunities, and centralize data collection. Table 5 summarizes these agencies' efforts.

Table 5

Agencies With Expertise to Address Beach Closings Problems
County Health Departments

The County Health Departments issue permits for the installation of individual homeowner septic systems. The LaPorte County Health Department samples bathing beaches that people frequent. Staff sample sites weekly between late May and late September. Each Friday morning, staff sample sites and the Health Department laboratory evaluates samples that day. The results are available before 10:00 a.m. Friday mornings. When *E. coli* concentrations exceed 235 cells/100 ml of water, the Health Department closes the beach for the weekend, retests on Monday and reopens the beach that Monday. The Porter County Health Department monitors only inland private lakes. As these lakes do not drain directly to Lake Michigan, this information does not directly relate to Lake Michigan beach closings. The Lake County Health Department samples at Whihala Beach.
City Health Departments

The East Chicago City Department of Public and Environmental Health monitors *E. coli* at Jeorse Park. The Hammond Health Department tests water quality for bacteria concentrations at Wolf Lake swimming beaches. Data on Wolf Lake, not directly draining to Lake Michigan, does not directly relate to Lake Michigan bathing beaches. All other cities rely on INDU for information on *E. coli* concentrations.
National Park Service

Since 1984 staff with INDU have sampled water quality in the nearshore waters of Lake Michigan. Between 1984 and 1989, staff sampled water for fecal coliform and since 1990 staff have been sampling water for *E. coli*. The National Park Service's extensive database can help agencies correlate bacteria levels with other environmental parameters.

U.S. Geological Service, Biological Resource Division

The Biological Resource Division of the USGS has studied *E. coli* concentrations in the area of INDU, Indiana Dunes State Park and Porter and LaPorte counties. In 1990 and 1991 staff examined the origin of fecal contamination in Derby Ditch and Dunes Creek. Staff closely studied concentrations of *E. coli* in beach sand and shallow groundwater at

the National Lakeshore. Additionally, staff sampled five tributaries of Burns Ditch weekly over three months to compare bacteria concentrations with daily weather conditions.

U.S. Geological Survey, Water Resource Division

USGS staff operate various stream gages, acoustic velocity meters and monitoring wells through the area. There are 76 groundwater wells and 24 surface water sites in Indiana's portion of the Lake Michigan basin. Four velocity meters compute continuous discharge. These locations each have one meter: Trail Creek at Michigan City Harbor, Indiana Harbor Canal at East Chicago, Burns Ditch at Portage, and Grand Calumet River at East Chicago. USGS also maintains various databases that integrate with a geographic information system (GIS). USGS staff in Indianapolis are working in several projects that relate to beach closings.

Evaluating the chemistry of water through and around slag piles
Impact of road salt on the groundwater chemistry near the Great Marsh
Measuring the depth of fill in northwestern Lake County
Assessing wet deposition at the Gary Airport
With the U.S. Army Corps of Engineers, computing suspended and bedload sediment loads in the Indiana Harbor Canal

U.S. Environmental Protection Agency

Staff with U.S. EPA have sampled Salt Creek, a tributary of the Little Calumet River, to collect information for enforcement. Results of these samples may provide information on E. coli concentrations in this tributary.

Indiana State Department of Health

In residential areas with septic systems, staff can conduct door-to-door visits to determine where systems are not operating properly. The Department of Health also publishes operating guidelines for residential and commercial septic systems.
Indiana Department of Natural Resources

IDNR personnel have compiled data to help evaluate correlations between land use and water quality in the State's portion of the Lake Michigan basin. Staff can integrate this information in a GIS. The DNR's Lake Michigan Specialist provides technical assistance to agencies and communities about coastal dynamics. The Division of Outdoor Recreation helps administer a volunteer water quality testing program for several parameters, including E. coli. The Lake Michigan Coastal Coordination Program will provide opportunities for agency cooperation in addressing environmental issues.
Indiana Department of Environmental Management

Staff from IDEM conduct stream sampling and water quality surveys. IDEM staff integrate this information in a GIS. The Office of Water Management's Assessment Branch plans to reevaluate the Lake Michigan basin between 2000 and 2001. On a monthly basis fixed water quality monitoring stations provide data on water quality parameters for certain tributaries and nearshore areas on Lake Michigan. IDEM will annually publish data on bacterial concentrations from sampling sites in Lake, Porter and LaPorte counties. This information can be found in the annual 305(b) report.

IDEM staff are working with cities to install clean vessel pump-out stations at marinas. Staff from IDEM conduct periodic inspections and compliance evaluations of both municipal and industrial facilities that potentially contribute to water quality degradation. Staff conduct complaint investigations that allege water quality degradation. Staff are responsible for preparing National Pollution Discharge Elimination System permits, which regulate E. coli bacteria discharges to Lake Michigan tributaries. Staff are responsible for reviewing combined sewer overflow operational plans, which are designed to reduced and/or limit sewage discharges.

Indiana Geological Survey, Indiana University

Staff with IGS maintain a database on the geology of northwest Indiana. Staff can provide information in these databases in a GIS. Using this information, staff have undertaken several hydrologic studies in the area. Currently, IGS is monitoring hydrologic conditions in the Great Marsh and is helping construct a pilot wetlands restoration project. This project should help reduce bacteria that contaminate Derby Ditch. The IGS has proposed to the National Science Foundation a monitoring study of the Trail Creek Watershed to determine sources of E. coli and other pollutants into the drainage, and a pilot study to develop GIS coverages of the area.

Illinois-Indiana Sea Grant

Sea Grant has funded various research projects throughout the Great Lakes. As staff with Sea Grant determine upcoming research priorities, they may consider prioritizing E. coli research. Illinois-Indiana Sea Grant did fund a project that studied methods to distinguish human and animal sources of E. coli.

Northwestern Indiana Regional Planning Commission

NIRPC has coordinated water quality planning efforts for Trail Creek and the 208 Water Quality Management plan.

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